

REMARKS/ARGUMENTS

In response to the Office Action mailed December 22, 2005, Applicants request reconsideration based upon the following remarks. No claims are added or cancelled and no claims are amended. Accordingly, claims 1-19 remain pending.

The invention as described in independent claim 1, the only pending independent claim, relates to a method of manufacturing a semiconductor device. More specifically, the invention relates to the manufacturing of a via hole extending through a series of films and to a conductive layer in a substrate. The conductive layer and the substrate are first covered by a stopper film, on which an interlayer insulating film is then deposited. Then, a capping film is deposited on the interlayer insulating film.

In order to form the via hole, a photoresist film having a particular pattern is formed on the capping film. Then, using the resist film as a mask, the capping film and the interlayer insulating film are etched to form an opening that extends through those two films to the stopper film. The etchant employed does not etch the stopper film, providing the basis for identifying that film as a stopper film.

In the final steps of the claimed process, the resist film is left in place, after etching the capping film and the interlayer insulating film, and a different etchant is employed to etch the exposed part of the stopper film to complete the via hole. Only after etching the stopper film is the resist film removed in an ashing process.

In the previous Office Action, the only rejection of claim 1 was a rejection for obviousness over Wang et al. (U.S. Patent 6,124,201, hereinafter Wang) in view of Savas et al. (U.S. Patent 6,805,139, hereinafter Savas). This rejection was traversed in the response filed December 7, 2005. The rejection was a final rejection and the Examiner withdrew that rejection in the new non-final rejection of the Office Action mailed December 22, 2005. However, the new rejections are not completely understood.

According to the Office Action mailed December 22, 2005, unspecified claims were rejected as obvious over Lee et al. (U.S. Patent 6,815,331, hereinafter Lee) in view of Robinson et al. (U.S. Patent 4,201,579, hereinafter Robinson) and further in view of Robb (U.S. Patent 4,529,860). Because of the uncertainty concerning which claims were

subject to this rejection, Applicants' representative communicated informally with the Examiner and suggested that it was intended that claims 1, 2, 7-11, and 15-19 were so rejected. The Examiner concurred with this suggestion.

In the Office Action mailed December 22, 2005, another group of unspecified claims was rejected as unpatentable over Lee in view of Robinson and Robb and further in view of Savas. Again, because of the uncertainty concerning which claims were the subject of this rejection, in an informal communication with the Examiner, Applicants' representative suggested that claims 3 and 16 were so rejected. The Examiner concurred. However, upon further study of the Office Action, it was discovered that the comments concerning this rejection and appearing at pages 3 and 4 of the Office Action were simply a reproduction of parts of the rejection in the Office Action mailed September 15, 2005 based upon Wang in view of Savas, not Lee, Robinson, Robb, and Savas. In fact, there is no attempt to rely upon any of Lee, Robinson, or Robb in this rejection. Accordingly, upon further consideration, it is believed that this rejection was unintentionally carried over from the Office Action mailed September 15, 2005. Applicants respectfully request a clarification. In the meantime, since the rejection and the associated remarks cannot be aligned, there is no response to the second rejection. To the extent Wang is now again relied upon, Applicants incorporate by reference the comments appearing in the response filed December 5, 2005, which the Examiner has apparently concluded overcame the rejection based upon Wang as the principal reference.

Claims 4-6 and 12-14 were rejected as unpatentable over Lee in view of Robinson and Robb, and further in view of a description appearing in the IBM Technical Disclosure Bulletin (hereinafter IBM TDB). It is understood, based upon claim dependencies, that this rejection was intended to be made with respect to claims 3-6 12-14, and 16. Again, clarification is requested. All rejections made in the Office Action mailed December 22, 2005 are respectfully traversed.

Of the four publications understood to be applied in rejecting the pending claims, only Lee was relied upon as allegedly disclosing the basic elements of claim 1, the sole pending independent claim. Although stated above, Applicants again emphasize that, in the invention, after etching the capping film and the interlayer insulating, using the resist

film as a mask and exposing the stopper film, the resist film is left in place while the exposed part of the stopper film is removed by etching. Only after etching of the stopper film is the resist film removed by ashing. This important feature of the invention, described above, namely leaving the resist film in place until after etching the stopper layer, is not addressed in the comments of the Office Action mailed December 22, 2005. In addition, Lee never discloses or even suggests such a step.

In applying Lee, attention was directed to Lee's Figure 37 which is the first figure in a series of figures describing forming of a via hole. The description of the Lee process that appears in the Office Action is entirely consistent with the disclosure of Lee regarding Figures 37-39 that appears in columns 15 and 16 of Lee. In Figure 37, as identified in the Office Action, the resist mask is element 710. Applicants agree that the layers 704, 706, and 708 of Figure 37 can be compared to the stopper film, the interlayer insulating film, and the capping film, respectively, of the claimed invention. However, the comparison to claim 1 breaks down because Lee expressly describes, in column 16, lines 32-34, removing the photoresist pattern 710 by ashing before etching the stopper film 704. In fact, numerous steps are carried out after removing the photoresist pattern 710 and before removing any part of the stopper film 704 to produce the structure shown in Figure 43 of Lee. Thus, Lee fails to supply an important part of the invention that has been emphasized not only in independent claim 1, but also in the previous response.

Robinson and Robb are both directed to techniques of etching or removing photoresist or like materials and include no relevant disclosure with regard to leaving in place a photoresist mask while the stopper film within an opening, defined using the photoresist mask, is removed. Savas, if applicable to any rejection now pending, is likewise silent as to this important feature of claim 1 and all pending claims. Further, IBM TDB is only related to particular ashing techniques and does not contribute any potentially relevant teaching that could be employed to modify Lee and suggest the invention as defined by claim 1.

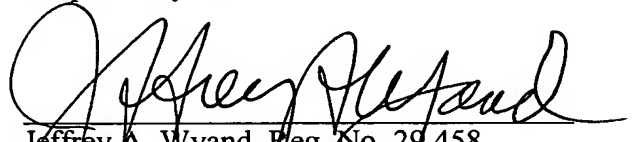
As already pointed out, in the invention, the original resist film is left in place even after the etching of the interlayer insulating film and is used in etching the stopper film to complete the formation of the via hole. As described in the patent application,

particularly with respect to Figure 7C, if the resist film is removed early, then the via hole becomes undesirably enlarged in area and tapered in cross-sectional shape. This result occurs because the etchant etching the stopper film etches not only the stopper film but also the exposed part of the capping film, from which the resist has been removed, and the interlayer insulating film. The tapering is avoided in the invention by leaving the resist film in place until after the stopper layer has been etched. In other words, the continued presence of the resist film is not merely accidental or unrelated to the result that is achieved. The presence of the resist film is important to control the shape of the via hole. No such mask is present in Lee in any step after exposing the stopper film.

In order to demonstrate *prima facie* obviousness of a claim, it is critical that all of the elements of the claim be shown to be present in the prior art. If all of the elements of the claim are present in the prior art, then it is also critical to demonstrate that one of skill in the art would combine the elements as in the claimed invention in order to show that the invention is obvious and not patentable. Here, the first of these two essential requirements is missing so that the second requirement cannot even be considered. Lee, like the prior art described in the patent application, removes the photoresist before the etching of the stopper layer. Since none of Lee, Robinson, Robb, or Savas, much less Wang, and IBM TDB, describes an important feature of all pending claims, *prima facie* obviousness of claim 1 and of its dependent claims 2-19, has still not been established.

Because the rejection of claim 1 is deficient, Applicants respectfully request reconsideration and allowance of that claim 1 and of all of claims 2-19, since those claims all depend directly or indirectly from claim 1.

Respectfully submitted,



Jeffrey A. Wyand, Reg. No. 29,458
LEYDIG, VOIT & MAYER
700 Thirteenth Street, N.W., Suite 300
Washington, DC 20005-3960
(202) 737-6770 (telephone)
(202) 737-6776 (facsimile)

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